Disturbed body integrity and the "rubber foot illusion"

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Abstract: Objective: Xenomelia, that is, the nonacceptance of one's own limb, is an intriguing but little understood condition. We sought to further test the most prominent neuroscientific hypothesis that suggests xenomelia results from a breakdown in multisensory integration for the affected body part. Method: A "rubber foot illusion" paradigm was developed and tested in healthy participants and in individuals with a desire for left foot amputation (xenomelia). Behavioral and physiological responses quantified illusory ownership of a fake foot after synchronous and asynchronous stroking of a visible rubber foot and the subject's own hidden foot. Results: Healthy participants (n = 15) showed a rubber foot illusion similar to the well-known rubber hand illusion. Individuals with xenomelia (n = 9) experienced the rubber foot illusion in a way comparable to healthy controls. The only difference in the individuals with xenomelia was an increase in the vividness of the illusion for the undesired limb. This vividness of the illusion correlated positively with the strength of amputation desire. Conclusion: These findings might reflect the malleable sense of the body in xenomelia and suggest a weakened representation of the affected body part. These findings may support the use of multisensory stimulation in therapeutic settings. (PsycINFO Database Record (c) 2014 APA, all rights reserved).

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Disturbed Body Integrity and the “Rubber Foot Illusion”

Abstract

Objective: Xenomelia – i.e. the non-acceptance of one's own limb – is an intriguing but little-understood condition. This study aimed to further test the most prominent neuroscientific hypothesis that suggests it results from a breakdown in multisensory integration for the affected body part.

Method: A "rubber foot illusion" paradigm was developed and tested both in healthy participants as well as in individuals with a desire for left foot amputation (xenomelia). Questionnaire, behavioral and physiological responses quantified illusory ownership of a fake foot after synchronous and asynchronous stroking of a seen rubber foot and the hidden own foot.

Results: Healthy participants (n=15) showed a rubber foot illusion similar to the known rubber hand illusion. Furthermore, individuals with xenomelia (n=9) experienced the rubber foot illusion in a comparable way to healthy controls. The only difference was an increased vividness of the illusion for the undesired limb. This vividness of the illusion was further positively correlated to the strength of amputation desire.

Conclusions: These findings might reflect the malleable sense of the body in xenomelia and suggest a weakened representation specifically of the affected body part. They might further pave the way for the use of multisensory stimulation in therapeutic settings.

Keywords: Body image identity disorder (BIID), multisensory integration, amputation desire, xenomelia, neuropsychiatry

Xenomelia designates the non-acceptance of one or several limbs by non-psychotic individuals (McGeoch et al., 2011). Usually first noticed in childhood, the failure to integrate the limb into one's bodily self typically gets stronger during puberty and may culminate in a desire for amputation (First, 2005). While the desire for amputation is its best-known form, variants of such a desire for physical disability (e.g. the desire for paraplegia or blindness) have been described under the umbrella term "body identity integrity disorder" (BIID, First & Fisher, 2012). Xenomelia was originally conceived as a psychiatric disorder (e.g. Smith, 2004), but evidence for a neurological basis of xenomelia is increasing (Brang, McGeoch, & Ramachandran, 2008; Hilti et al., 2013; McGeoch et al., 2011; van Dijk et al., 2013). Emphasizing the similarities with neurologically caused disorders of disownership (e.g. somatoparaphrenia (Vallar & Ronchi, 2009), these studies commonly hypothesize disturbances in the multisensory representation of the affected body part. Brang and co-authors (2008) found reduced galvanic skin responses to tactile stimulation of non-accepted vs. accepted parts of the body in two patients, pointing to insular cortex dysfunctions. A magnetoencephaloraphic study of the same group suggested reduced responsivity of the right superior parietal lobule in response to tactile stimulation (McGeoch et al., 2011). Both these structures as well as somatosensory areas also showed structural abnormalities in morphometric measures (Hilti et al., 2013). A recent fMRI study further found altered somatosensory processing in the premotor cortex (van Dijk et al., 2013). Generally, these studies converge in their conclusion that xenomelia may be accompanied by alterations in the key brain circuits responsible for unifying various sensory inputs into a coherent sense of body (e.g. see e.g. (Tsakiris, 2010) for such a model of body ownership).

Individuals who suffered from xenomelia and proceeded to realize their desire (i.e. the limb was amputated) report substantial relief (First, 2005). But facing the dangers of nonprofessional or self-attempted surgery, the disability it inevitably incurs and ethical concerns about amputations on demand (see target article (Müller, 2009) and related commentaries in the special issue of The American Journal of Bioethics), the development of alternative treatment methods appears desirable. Psychotherapeutic interventions have been broadly unsuccessful (Bou Khalil & Richa, 2012), and isolated pharmacological treatment attempts have alleviated suffering, but not "cured" xenomelia (Johnston & Elliott, 2002).

Against this background we set out to test whether a neurological perspective on xenomelia could open up an avenue to behavioral treatments for the disorder. We adapted a classic paradigm to investigate limb ownership and body-self integration, i.e. the rubber hand illusion (RHI, (Botvinick & Cohen, 1998)). In this paradigm, the synchronous stroking of an observed fake hand and one's own hidden hand leads to an illusory feeling of ownership for the fake hand. Alongside this change in body awareness, the illusion has also been shown to alter various aspects of the bodily self, including reduced tactile acuity, biased proprioception towards the fake hand (Botvinick & Cohen, 1998), decreased body temperature (Moseley et al., 2008) and increased immunological response (Barnsley et al., 2011). The rubber hand illusion, which is also thought to reflect a disturbed multisensory integration, has been associated with similar cortical areas to those implicated in xenomelia, namely insular, premotor and posterior parietal areas (e.g. Ehrsson, Spence, & Passingham, 2004; Ehrsson et al., 2004; Tsakiris, Hesse, Boy, Haggard, & Fink, 2007). As the desire for amputation is more commonly present for lower limbs

(Blanke, Morgenthaler, Brugger, & Overney, 2009), the paradigm was adapted to foot stimulation and only individuals with a desire for lower limb amputation were included in this study. Based on above mentioned literature we hypothesized a disrupted multisensory integration and thus an attenuated rubber foot illusion (RFI) specifically for the affected foot, that would be reflected in all classical measurements of the illusion, i.e. self-report and proprioceptive drift (Botvinick & Cohen, 1998), as well as skin temperature (Moseley et al., 2008).

Methods

Participants

Fifteen healthy men (mean age of 45.7 (SD 18.0) years) and 9 male individuals suffering from xenomelia (mean age 48.2 (SD 14.2), t=0.35, p=0.73), see table 1 for more details) were tested. The participants with xenomelia were recruited via the Internet and selected based on the presence of a longstanding desire for amputation of one lower left limb. All participants reported an uneventful medical history without any known complications during pregnancy and a normal child development. All participants had normal or corrected-to-normal vision and were naïve as to the purpose of the study. The local Ethics Committee had approved the study and all participants provided written informed consent.

*** **Insert Table 1** about here ***

Experimental set-up and procedure

We developed a rubber foot illusion (RFI) paradigm, matching as closely as possible the setup of the original RHI paradigm (Botvinick & Cohen, 1998). Participants were tested barefoot

in a sitting position with both feet placed on the ground. A realistic looking rubber foot (either left or right congruent to the stimulated foot) was placed between the participant's feet at a distance of 20cm to the stimulated foot. The real feet were covered from sight with a black cloth (see Figure 1A). The left or right hidden foot and the seen rubber foot were stroked with two identical paintbrushes (see Figure 1B) either synchronously or asynchronously. The stroking was applied during 4 minutes in an irregular manner. The order of the resulting four conditions (left foot synchronous, right foot synchronous, left foot asynchronous, right foot asynchronous) was counterbalanced across participants. Each condition lasted about seven minutes and included all three measurements described below.

Measurements

Neurological status: A neurological status including examination for pain, temperature, vibration, and position sense as well as extensive neuropsychological evaluations was done in order to check that the basic neurological functions are normal.

General psychiatric assessment: Psychiatric assessment was deemed necessary to exclude that a participant's amputation desire would be rooted in one of the classical psychopathological disorders listed in the DSM-IV. It comprised a 2-h structured clinical interview to diagnose axis I and II disorders (Wittchen & Frydrich, 1997). Furthermore the following scales were given to the participants:

- Body Dysmorphic Disorder, which was measured by the German “Fragebogen zur Beurteilung des eigenen Körpers” (Strauss, 1996), which includes 52 items on the subjective experience of the body.

- Borderline symptoms List (Bohus, Limberger, Sender, Gratwohl, & Stieglitz, 2001), which was developed to quantify the intrapsychic strain of patients with borderline personality disorder. It contains 105 statements to be responded on a 5–point Likert scale.
- Obsessive-Compulsive Inventory (Gönner, Leonhart, & Ecker, 2007), which includes 18 items to assess obsessive and compulsive behavior on 5-point Likert scales.
- Schizotypal Personality Questionnaire (Klein, Andresen, & Jahn, 1997), a 74-item scale that is modeled on DSM-III-R criteria for schizotypal personality.
- Depression Anxiety Stress Scale (Crawford & Henry, 2003), a 42-item instrument designed to measure the three interrelated negative emotional states of depression, anxiety and tension/stress.
- Barratt Impulsiveness Scale (Preuss et al., 2003), a 30-item scale designed to assess the personality construct of impulsiveness.
- " Fragebogen für Dissoziative Symptome" (Spitzer, Mestel, Klingelhöfer, Gänsicke, & Freyberger, 2004), a 44-item scale developed to assess symptoms of dissociation.
- Personal Attributes Questionnaire (Runge, Frey, Gollwitzer, Helmreich, & Spence, 1981), a 24-item scale measuring a participant's masculinity and femininity, respectively.
- Gender Identity (Eckloff, 2003), a 32-item scale assessing gender roles.
- Bem Sex Role Inventory (Schneider-Düker & Kohler, 1988), a 50-item scale measuring masculinity-femininity and gender roles.

Assessment of the desire for amputation: The strength of the individual's desire for amputation was assessed with the Zurich Xenomelia Scale (ZXS; Aoyama, Krummenacher, Palla, Hilti, & Brugger, 2012) for items see Table 2). This instrument contains 12 statements to

which the participant responds on a Likert-type scale from 1 (strongly agree) to 6 (strongly disagree). Based on Bruno (1997), the items can be grouped in three subscales (i.e. pure amputation desire, erotic attraction and pretending behavior).

*** **Insert Table 2** about here ***

Questionnaire on subjective experience during the rubber foot illusion. A questionnaire assessing illusory change in body perception was identical to the one used by Bovinick and Cohen (1998); except that the word "hand" was replaced with the word "foot" (see Table 3 for the items). As proposed by these authors, and in line with previous literature (Lenggenhager, Pazzaglia, Scivoletto, Molinari, & Aglioti, 2012) the items of the questionnaire were grouped into illusion-relevant questions (Q1-Q3) and control questions (Q4-Q9).

*** **Insert Table 3** about here ***

Proprioceptive drift after the RHI. To assess proprioceptive drift, participants had to indicate the felt position of their hidden big toe before and after each tactile stimulation. For this, a ruler was placed over the participants' feet (see Figure 1c). Different rulers with different offset were used for each condition in order to prevent memory effects. Proprioceptive drift was calculated by subtracting the post-stimulation judgment from the pre-stimulation judgment.

Skin temperature during the RHI. Following the protocol of Moseley and coauthors (2008) skin temperature was simultaneously assessed on the stimulated and the unstimulated foot

every 20 seconds using infrared thermometry (IRtek, IR15, Australia). The thermometer was always placed on the exact same position (besides the ankle) where the participant had not been touched during stroking, see Figure 1D). The 6 successive temperature measurements from the 4 minutes of stimulation were averaged separately for each foot and a pre-stimulation baseline measure was subtracted.

*** **Insert Figure 1** about here ***

Data handling

We first analyzed the data of the healthy participants in order to test if it is possible to induce a rubber foot illusion in our set up. Repeated measure ANOVAs with the within factors SIDE (left foot stimulated, right foot stimulated) and STIMULATION (synchronous, asynchronous stroking) were calculated for all three measurements. For the questionnaire we further added the factor ITEM (illusion versus control items) and for the temperature the factor MEASURED FOOT (stimulated versus non-stimulated foot). The significance level was set at $p = 0.05$.

In a second step, we compared the participants with xenomelia to the sample of healthy controls. Due to small and unequal sample sizes, non-parametric tests for independent samples (Mann-Whitney U tests) were used for all variables of interest (i.e. the variables that showed an effect in healthy participants, namely proprioceptive drift and illusion questions). As a total of 8 comparisons (four conditions for each of the measures) were calculated, the p-value was Bonferroni-corrected by adjusting the significance level to a value of 0.0065. A Spearman correlation was calculated between the Zurich Xenomelia Scale and the measure that

significantly differs between healthy participants and individuals with xenomelia. To check for differences between personality and other relevant psychological traits between groups, the nonparametric test (chi square) were used to compare the results of the questionnaires.

Results

A "rubber foot illusion" paradigm in healthy participants

Subjective experience. A 2x2x2 ANOVA on the questionnaire ratings with the within factors SIDE (left foot, right foot), STIMULATION (synchronous, asynchronous stroking) and ITEM (illusion items Q1-3, control items Q4-Q9) revealed a significant main effect of STIMULATION ($F(1,14) = 9.7$, $p= 0.008$, $\eta 2=0.41$) with higher scores after the synchronous condition, a main effect of ITEM ($F(1,14) = 42.0$, $p< 0.001$, $\eta2=0.75$) with higher scores on the illusion items as well as an interaction effect between the two factors ($F(1,14) = 11.0$, $p= 0.005$ $\eta2=0.44$). The interaction between SIDE and ITEM was also significant ($F(1,14) = 5.1$, $p= 0.04$, $\eta 2=0.27$), indicating, independent of stroking, higher scores for the illusion items for the left as compared to the right foot.

Proprioceptive drift. A 2x2 ANOVA on the proprioceptive drift with the factors SIDE and STIMULATION revealed a significant effect of STIMULATION ($F(1,14) = 6.9$, $p=0.02$, $\eta2=0.33$) with stronger drift towards the rubber foot during the synchronous as compared to the asynchronous stroking. There was no effect of SIDE ($F(1,14) = 0.8$, $p=0.39$, $\eta2=0.05$) nor any interaction ($F(1,14) = 0.15$, $p=0.96$, $\eta2=0.00$).

Temperature. A 2x2x2 ANOVA on the temperature data with the factors SIDE, STIMULATION, and MEASURED FOOT (stimulated, unstimulated) revealed no significant main or interaction effect (all F-values < 2.3, corresponding p-values > 0.15, $\eta 2$ values <0.30).

The RFI in individuals suffering from xenomelia

Results are sown in Table 4. Participants suffering from xenomelia differed from control participants with respect to one single measure, i.e. the subjective rating of the illusion's vividness, specifically for the affected left foot. This measure (Spearman's rho = 0.7, p=0.04) was further significantly and positively correlated the strength of the amputation desire reflected in the ZXS – a correlation that was even strengthened if general answer bias were corrected by taking the relative value of illusion questions minus control questions (Spearman's rho = 0.853, p=0.003, Figure 2). Such correlations were entirely absent for the unaffected right foot (Spearman's rho = 0.02, p=0.96 and rho = -0.078, p=0.841 respectively).

*** **Insert Figure 2 and table 4** about here ***

Psychopathology and personality traits of the two groups

The psychiatric interview did not reveal any indication of the presence of axis I or axis II disorders in the persons with xenomelia. The two participant groups did not differ in their scores on the various scales to exclude psychopathology or assess personality. Please see table 5 for mean scores and the statistics.

*** **Insert Table 5** about here ***

Discussion and Conclusion

We showed that, similar to the well-known rubber hand illusion, a rubber *foot* illusion could be elicited in normal volunteers once stimulation conditions are adjusted to the lower limbs. This is shown both by a proprioceptive drift towards the fake foot after the synchronous stimulation as well as by the subjective vividness of the illusion, but we did not find the expected effect on body temperature (cp. Moseley et al., 2008). This finding makes the rubber foot illusion (RFI) paradigm an interesting candidate to test (disturbed) integration of multisensory signals that has been suggested to underlie altered foot ownership in individuals with xenomelia.

The participants with xenomelia reported a prominent and longstanding desire for an amputation of the left leg, but did not show significant signs of psychopathology on clinical questionnaires nor did they score differently from the healthy participants on various personality scales. With respect to the rubber foot illusion susceptibility, the comparison of the participants with xenomelia with the healthy sample revealed two important findings. First, contrary to what we had expected on the basis of a postulated multisensory integration deficit, the results both from the proprioceptive drift and from the questionnaire data showed that the RFI *could* be evoked even in an unwanted limb. This suggests that not only are the basic senses functioning normally but also that the integration of visual, tactile and proprioceptive information and visual capture is broadly intact. Either this finding suggests that theories of disturbed multisensory integration are not the sole explanation of xenomelia, or it implies that transient alterations of limb ownership during the rubber foot illusion do not directly reflect those experienced continuously by individuals with xenomelia. Either way we believe that this finding might have important clinical consequences as it opens up the possibility of using multisensory bodily illusions in a therapeutic framework. The fact that persons with xenomelia can feel ownership for

an artificial foot (as reflected by a significant proprioceptive drift), while they deny ownership for their real leg, could be used for behavioral training. Such training could aim to modify body representation and re-integrate the affected body part e.g. by using virtual reality setups that proved useful in other therapeutic contexts (Moseley, 2007).

The second finding showed an enhanced illusion susceptibility of the individuals with xenomelia compared to the healthy participants. This was specific to the undesired foot yet apparent only in the questionnaire data, but not for the assessment of proprioceptive drift. Within the participants with xenomelia, the strength of the illusion was correlated with the strength of the amputation desire. This result might tie to weakened sense of limb ownership reflected in a more malleable body representation. Such stronger malleability has been shown using the RHI paradigm in other patients with disorders of the bodily self such as patients with schizophrenia (Peled, Pressman, Geva, & Modai, 2003; Peled, Ritsner, Hirschmann, Geva, & Modai, 2000; Thakkar, Nichols, McIntosh, & Park, 2011) or patients with eating disorders (Eshkevari, Rieger, Longo, Haggard, & Treasure, 2012; Eshkevari, Rieger, Longo, Haggard, & Treasure, 2014). Interestingly, even in healthy participants a weak bodily self awareness is associated with a stronger RHI (Tsakiris, Tajadura-Jimenez, & Costantini, 2011), and experimentally cooling down the temperature of the real hand has been shown to facilitate the RHI (Kammers, Rose, & Haggard, 2011). While the finding of a stronger illusion for participants with xenomelia could suggest reduced proprioception and/or heightened visual capture, such an interpretation has its own caveats: the more pronounced susceptibility was limited to the *consciously* rated illusion vividness. In view of the selective finding for explicit, but not implicit measures, effects of suggestibility cannot be excluded. Nevertheless, as xenomelia participants' scores differed from those of healthy participants exclusively after synchronous (i.e. illusion inducing), but not after

asynchronous stroking, this hypothesis seems rather unlikely. Yet, the selective effect could give some hints on underlying neural mechanisms. Initially taken as a mere behavioral proxy of illusory ownership, the more recent literature suggests that the proprioceptive drift measures a distinct aspects of ownership (e.g. Rohde, Di Luca, & Ernst, 2011) and are presumably based on distinct brain mechanisms. While the proprioceptive drift has been associated with insular activity and posterior parietal areas (e.g. Tsakiris et al., 1996), the vividness of the illusion has been found to correlate with premotor activity (e.g. Ehrsson, Holmes, & Passingham, 2005) corroborating recent fMRI findings of disturbed sensory processes in the premotor cortex (van Dijk et al., 2013).

In conclusion, the data suggest that a rubber foot illusion can be induced both in healthy participants as well as in individuals with disturbed body part ownership due to xenomelia. Crucially, the latter showed a more pronounced illusion for the affected body part, corroborating its purportedly poor central representation.

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Tables

Table 1

Characteristics of the participants with xenomelia

Nr	Age [years]	Height of desired amputation	Desire since the age of [years]	ZXS total score
1	41	10cm above knee	8-10	4.6
2	46	Middle of thigh	“Since I can remember”	4.5
3	63	At upper third of thigh	7	4.0
4	57	Middle of thigh	6-8	4.3
5	29	Middle of thigh	4-5	5.1
6	28	15 cm below hip	7	5.4
7	44	15 cm below hip	9	4.3
8	61	15 cm above knee	7	5.0
9	67	10 cm above knee	8	5.0

Table 2:

Items of the Zurich Xenomelia Scale

Item nr	Sub-scale	Item
1	A	My desire for amputation is so strong that it determines my life
2	A	I have never played with the thought to amputate myself / to provoke an accident
3	E	If I could choose between a sexual partner with an amputation and one without (everything else equal), I would go for the one without amputation
4	P	I am far from moving and behaving as if I were amputated
5	A	Despite the fact that I would have a body part removed, I would feel more „complete“ and myself after the desired amputation
6	E	If I were amputated, I would experience myself as more erotic
7	P	Instruments commonly used by amputees (prostheses, crutches, calipers, wheelchairs) do not fascinate me in any way
8	P	I sometimes pretend (for myself or for others) to be amputated
9	E	The theme of amputation plays an important role in my erotic fantasies
10	A	However present, my desire for amputation is probably rather playful, i.e. a not-so-serious fantasy
11	P	If I succeeded to make people around me believe that I am already amputated, it could reduce my desire for actual amputation
12	E	For myself, the desire for amputation does not have any erotic or sexual connotation

Note: Modified after Anoyma et al (2012). A = subscale ‘pure amputation desire’, E = subscale ‘erotic attraction’, P = subscale ‘pretending behavior’

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Table 3:

Items of the rubber foot illusion questionnaire

No.	Item
Q1	It seemed as if I were feeling the touch of the paintbrush in the location where I saw the rubber foot touched.
Q2	It seemed as though the touch I felt was caused by the paintbrush touching the rubber foot.
Q3	I felt as if the rubber foot were my foot.
Q4	It felt as if my (real) foot were drifting towards the right/left (towards the rubber foot).
Q5	It seemed as if I might have more than one left/right foot or leg.
Q6	It seemed as if the touch I was feeling came from somewhere between my own foot and the rubber foot.
Q7	It felt as if my (real) foot were turning 'rubbery'.
Q8	It appeared (visually) as if the rubber foot were drifting towards the left/right (towards my foot).
Q9	The rubber foot began to resemble my own (real) foot, in terms of shape, skin tone, freckles or some other visual feature.

Note: Modified after the classical rubber hand illusion questionnaire (Botvinick & Cohen, 1998). The illusion-relevant items are highlighted in gray.

Table 4

The rubber foot illusion: Results of the comparison between individuals with xenomelia and the control group.

Condition	**Healthy**		**Xenomenlia**		**Mann Whitney**	**Effect size**
Questionnaire	**Median**	**IQR**	**Median**	**IQR**		
Left synchronous	0.33	2.67	3.00	1.00	p=0.002*	0.61
Left asynchronous	-2.33	2.33	-2.00	5.00	p=0.60	0.11
Right synchronous	0.33	3.67	1.67	3.67	p=0.19	0.26
Right asynchronous	-3.00	2.00	-3.00	2.50	p=0.60	0.13
Drift	**Mean**	**SEM**	**Mean**	**SEM**		
Left synchronous	0.48	0.35	1.50	0.47	p=0.26	0.23
Left asynchronous	-0.02	0.31	1.08	0.57	p=0.41	0.17
Right synchronous	0.06	0.05	0.72	0.55	p=0.56	0.12
Right asynchronous	-0.38	0.28	0.36	0.52	p=0.14	0.31

Note: The comparison was done for the relevant measures of the rubber foot illusions using a Mann Withney U test.

Table 5

Scores on the psychopathology and personality questionnaires

Scale	Participants				Statistical test	
	Healthy		With xenomelia		Mann Whitney	
	Median	IQR	Median	IQR	p-value	Effect size
BDD	24	5	26.5	8.25	0.30	0.25
BSL	0.42	0.30	0.48	0.30	0.18	0.27
OCI	8	15	11	6	0.51	0.13
SPQ	14	18	10	13	0.65	0.09
DASS	16	18	7	17	0.51	0.13
BIS	32	15	36	9	0.12	0.32
DS	3.86	5.45	5.90	3.52	0.33	0.20
PAQ	42	5	43	5	0.57	0.12
GI	64	10	61	7	0.11	0.32
BSRI	211	40	225	29	0.51	0.13

BDD = Body Dysmorphic Disorder; BSL = Borderline symptoms List; OCI = Obsessive-Compulsive Inventory; SPQ = Schizotypal Personality Questionnaire, DASS = Depression Anxiety Stress Scale; BIS = Barratt Impulsiveness Scale, DS = “ Fragebogen für Dissoziative Symptome”; PAQ = Personal Attributes Questionnaire; GI = Gender Identity, BSRI = Bem Sex Role Inventory

Figures

Figure 1. Experimental setup and measurements. A) Participants were tested in a sitting position and a looking rubber foot was placed between their hidden feet. B) The left or right hidden foot and the seen rubber foot were stroked synchronously or asynchronously. C) Proprioceptive drift was measured by judging the felt position of the big toe on a ruler over the participant's feet. D) Body temperature was assessed on both feet simultaneously every 20 seconds during the stimulations.

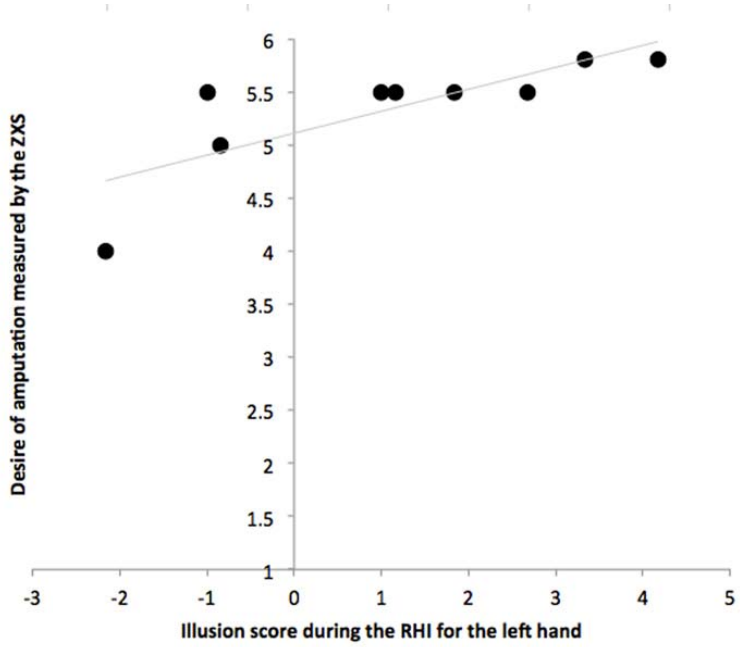

Figure 2. Correlation between the strength of the illusion (mean value of the illusion-relevant as compared to the illusion-irrelevant questions) and the desire for amputation according to the Zurich Xenomelia Scale.